DOCUMENT RESUME

ED 090 518 CS 001 076

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TITLE The Loci Mnemonic Technique in Learning and Memory.
PUB DATE Apr 74
NOTE 10p.; Paper presented at the Annual Meeting of the American Educational Research Association (59th, Chicago, Illinois, April 1974)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Cognitive Processes; College Students; *Educational Research; Learning; Learning Theories; *Memory; *Mnemonics; *Recall (Psychological); Retention

ABSTRACT

This study investigated the facilitative effects of the loci system using mental imagery for acquisition and recall within a retroactive inhibition (RI) paradigm. Fifty-five college undergraduates were randomly assigned to five treatment conditions. Four groups formed cells in a 2x2 factorial design which included (1) an RI factor (AB-AD vs. AB-CD), (2) a subject-generated vs. experimenter-supplied loci list (loci-generation factor); and (3) repeated measures for uncued and cued recall. The fifth group was a comparison control in which subjects merely learned and recalled word lists B and D without the aid of the loci mnemonic technique. The object names used to form word lists B and D were high imagery and concreteness nouns. The loci-generated group subjects visualized 12 locations in a setting with which they were highly familiar. This became word list A. The subjects in the AB-CD condition generated word list C in the same manner but in a different setting and with none of the words used in list A. Subjects were shown either list A or list C, and after achieving perfect recall were required to perform an uncued recall pairing those items with list B, followed by cued recall. The findings supported the conclusion that the loci mnemonic technique is of value in aiding recall. (WR)

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THE LOCI MNEMONIC TECHNIQUE IN LEARNING AND MEMORY[1]

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INTRODUCTION

As an introduction to this paper, let me tell you a story (with apologies to Yates, 1966, and to Cicero's De oratore).

Once upon a time, a nobleman named Scopas gave a big dinner party for a big crowd of friends. As part of the entertainment he hired a poet, named Simonides, to write and recite a poem honoring him and the occasion. In the poem Simonides praised his host as required, but incidently added a little praise for the gods Castor and Pollux[2]. Scopas was miffed at this, told Simonides that he'd pay only half the fee, and to get the rest from the gods.

Apparently, the gods paid off, because soon after, two young men appeared at the door and asked to meet with Simonides outside. He went out, found no one, but before he could get back to the party, the roof fell in. Naturally, as in all moralistic tales, Scopas and his guests were all crushed beyond recognition. The relatives were distraught as they couldn't figure out which body to bury in which family plot.

Simonides came to the rescue. He identified all the bodies by remembering the places at which everybody had been sitting when he left the party. Later, on reminiscing on the happening, his ability to identify the bodies by location suggested to him some mnemonic principles which are under investigation in the experiment to be described in this paper.

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[1] Paper presented at the annual meeting of the American Educational Research Association April, 1974, Sesson 12.10 Verbal Learning I.

[2] Twin demi-gods of Greek Mythology (Gimini Twins).

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He inferred that if we are to train memory we must learn to select places or locations, form mental images of things to be remembered, and then store the images in those places. The order of the places is used to preserve the order of things and, at retrieval, the image in each location denote the things themselves. Simonides' recommendations were important in the development of other memory systems over the centuries, were of interest to psychologists and educational researchers around the turn of this century, were ignored when psychology "lost its mind" during the heyday of behaviorism, and have been resurrected by the "Cognitive Revolution" (Dember, 1974). Naturally, they set the stage for some interesting, fun, and perhaps useful research: notably, the present experiment.

In the historical literature on mnemonic systems a convincing argument is made for the effectiveness of the loci mnemonic system (Yates, 1966). For the skeptic there have been some recent experimental demonstrations. For example, Ross and Lawrence (1968) reported that the use of the loci system not only facilitated recall, but eliminated serial position and interference effects. Other mnemonic systems have also received attention. Wood (1967) conducted an extensive study of the numerical peg word system in which a numerically keyed, rhymed sequence of words, e.g., one is a bun, two is a shoe, three is a tree, etc., is memorized to serve as a retrieval scheme for the to be remembered items.

In these systems emphasis is placed on the mental imagery of the subjects. Instructions indicate that either loci or pegs are to be related in some concrete visualizable fashion with the items to be learned. Bower (1970) discussed this idea in some detail and argues convincingly that indeed, some sort of covert visualization seems to be involved in the success of such systems. Additional evidence that imagery or visualization strategies facilitate recalling word lists has been presented by Paivio (1971) and his colleagues. In our experiment, investigating the use of the loci mnemonic system, we attacked a subtle question about the use and effect of imagery on recall.

The typical instructions for using the system indicate to the subject that he think of a set of familiar places that are connected structurally. For example, rooms in a building, or places in a room, or places along a commonly followed path from one's home to work, etc., are suggested. Implicit in such instructions is the idea that one has unique, experiential knowledge of these locations and their interrelationships (Bower, 1970). Such knowledge should lead to effective retrieval. In this experiment we undertook to test whether or not the subjective reality of the locations has any greater effect on recall than an arbitrary set of loci. Half of our subjects were asked to generate a list of locations with which they were familiar, and could 'walk through in their mind.' The others learned these loci well as a list of arbitrary places, and then, all subjects learned lists of concrete words pairing them with the loci.

We were intrigued also by the suggestion by Ross and Lawrence that the mnemonic scheme reduced or eliminated interference between successively learned lists. Bower and Reitman (1972) also indicated that interference could be eliminated by using certain procedures. They instructed subjects in the loci procedure and told them to include the new item along with the imagery generated for the old for each location as each list was presented. In this experiment we attempted to discover whether retroactive interference occurred using a rectroaction paradigm similar to those used in traditional verbal learning studies.

The details of the methods are presented in the appendix to the paper. Only the more significant aspects will be mentioned further at this time.

THE EXPERIMENT

The experiment was intended to obtain data regarding two questions. First, the notion that there is some special advantage for self-generated loci because of the subjective reality of the locations needed testing. Second, the finding that the technique produces resistance to interference needed further elaboration.

The study investigated the facilitative effects of the loci system for acquisition and recall within a retroactive inhibition (RI) paradigm. Fifty-five college undergraduates were randomly assigned to five treatment conditions (see Table 1). Four of these groups formed cells in a 2x2 factorial design which included on one dimension an RI factor (AB-AD versus AB-CD) and on the other dimension on S-generated versus E-supplied loci list (Loci-Generation factor). A third factor involved repeated measures for uncued and cued recall. The fifth group was a comparison control in which Ss merely learned and recalled Lists B and D without the aid of the loci-mnemonic. The object names used to form the B and D Lists were high imagery and concreteness nouns drawn from the Paivio, Yuille and Madigan (1968) norms. Twenty-four such nouns were randomly assigned to the two twelve-item lists.

The Ss in the Generate-Loci condition were told to write down a sequence of 12 locations in a setting which was highly familiar to them and which they could readily visualize. They were to imagine themselves walking from location to location and list these in the order in which they were encountered. They were to use one word descriptions of the loci and were not to repeat any word. They were given as much time as necessary for this and were prompted by E to remove ambiguities, duplicate items, etc. This was List A for the AB-AD or AB-CD conditions for an S. The Ss in the AB-CD condition were then asked to generate a second list (C) in the same way but in a different setting and with none of the words used in List A. Once an acceptable list (or lists) was generated, S was given 30 seconds to study it (or each list) followed by serial recall trials until a criterion of two perfect recalls was met for each list. He was then instructed that he would be shown a list of objects (List B) which was to be paired with the locations in List A by forming a mental image of the first object at the first location, the second object at the second location, and so on. The names of the 12 objects were projected on a screen at a 5-second rate followed by a serial recall trial. Study-recall trails continued until a criterion of one perfect recall

was obtained. At this point, S was shown either List A again (for the AB-AD condition) or List C (for the AB-CD condition) and given 30 seconds for review. A second list of object names (List D) was then learned under the same conditions as List B.

After a one minute period during which S counted backwards from 200 by 3s, uncued recall of List B was required followed by cued recall.

In the Given-Loci condition Ss were given the loci lists generated by the Ss in the Generate-Loci condition. They were also told to learn the lists by imagining themselves walking from place to place on the list. Thus, for each S in the Generate-Loci condition there was a yoked-control S in the Given-Loci condition who received identical instructions but did not have the "cognitive map" for the loci list. After a one minute period during which S counted backwards from 200 by 3s, uncued recall of List B was required followed by cued recall.

RESULTS

Mean trials to criterion on List B for the Generate-Loci, Given-Loci and the B-D control groups were 3.09, 4.18 and 2.82 respectively.[2] A significant one-way Anova for these groups $F(2,52) = 3.55$, $p < .05$, was followed by a Dunnett's t-test between the B-D control and the other groups. Only the Given-Loci condition differed significantly from the control. This suggests that the loci-mnemonic does not facilitate acquisition compared to a simple list-learning condition, and actually may inhibit learning when the loci list is not idiosyncratically meaningful.

A second question of interest was whether the presence of a self-generated loci list would facilitate retrieval over the no-loci B-D control with the potential for RI effects eliminated. The appropriate t-test between the Generate-Loci, AB-CD group (mean recall = 11.2), and the B-D control (mean recall = 9.00) indicated significant facilitation of recall from the loci mnemonic, $t(20) = 2.23$, $p < .05$.

Finally, a 2x2x2 mixed Anova between the Generate-Loci, RI and Cueing Factors was run. It was predicted that the loci mnemonic would only be facilitative where it was self-generated and that it would reduce the effects of RI for the Generate-Loci conditions but not for the Given-Loci conditions. Furthermore, if the loci-mnemonic functions primarily to provide an easily remembered list of retrieval cues only for Ss generating the list themselves, then differences between the Generate-Loci and Given-Loci conditons should diminish under cued recall where the loci cues were given to all Ss. This should occur despite the presence of imagery instructions and highly imageable list constituents.

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[2] Note that the AB-AD versus AB-CD distinction had not been made at this point in the procedure so this dimension was collapsed for this analysis.

Anova results indicated significantly better recall for the Generate-Loci condition, $F(1,40) = 14.88$, $p < .01$, and for Cued over Uncued recall, $F(1,40) = 11.40$, $p = < .01$. Furthermore, a significant ordinal interaction between the Generate-Loci and Cueing Factors $F(1,40) = 4.34$, $p < .05$, supported the interpretation that the loci technique functions primarily to provide retrieval cues which are not as readily available to Ss when the loci scheme is not idiosyncratic. The failure to find significant interference effects agrees with the findings of Ross and Lawrence (1968) and Bower and Reitman (1972).

These findings support the conclusion that the loci mnemonic is of value in aiding recall, but not in acquisition of meaningful verbal material. However, the data strongly support the cognitive position that the loci list must have subjective reality in order to operate effectively, and this, despite both imagery instructions and highly imageable list constituents.

TABLE 1

Experimental Design
and Mean Number Items Recalled

	Retroaction	
	(A)B - (A)D	(A)B - (C)D
S Generated Loci	8.6 uncued 9.8 cued	11.2 uncued 11.4 cued
E Given Loci	4.9 uncued 7.5 cued	5.9 uncued 6.8 cued

A = List of Loci

C = List of Loci

B&D = List of concrete words

Comparison Control	B - D
	9.0

APPENDIX

Method

Subjects and Design

Sixty-six University of Illinois undergraduates participated to fulfill an introductory psychology course requirement. Eleven Ss were randomly assigned to each of six treatment conditions. In four groups two treatments were crossed, Ss either generated (Loci-generate) or were given (Loci-given) and learned lists in a retroactive inhibition paradigm or control (AB-AD or AB-CD).

Another group was an "ABD" control. This was the same as the Loci-generate AB-AD group except that when the D-list items were learned S was instructed to imagine each one paired with the corresponding B item for the A list location. This condition was introduced to prevent "extinction" of the B list items as an explanation for forgetting in this instance.

An additional control group (B-D control) merely learned lists B and D without the aid of the loci mnemonic.

Materials

The object names which composed lists B and D were taken from the Paivio, Yuille and Madigan (1968) norms. They were selected from those nouns with an I rating above six, a C rating above six, and "m" rating above five and a Thorndike Lorge frequency count above 40 occurrences per million. There were only 31 words which conformed to these criteria, and of these six were discarded because they were synonyms of other words on the list. One word was randomly discarded from the remaining 25 and two 12-item lists were constructed by randomly assigning the words to each. The resultant lists and the order of words in each is as follows: List B: Pipe, Shoe, Ticket, Nail, Clock, Engine, Car, String, Letter, Dress, Toy, Book; List D: Bottle, Apple, Coin, Stove, Bowl, Magazine, Flag, Flower, Doll, Potato, Newspaper, Pencil. These were photographed and made into slides for projection during the learning phase.

Procedure

The Ss were randomly assigned to conditions upon their appearance for the experiment. The Ss in the loci-generate conditions were told to write down a sequence of 12 locations in a setting which was highly familiar to them and which they could readily visualize. They were to imagine themselves walking from location to location and list them in the order in which they were encountered using one word descriptions and not repeating any word once it was used. They were given as much time as necessary for this and were prompted by E to remove ambiguities,

duplicate items, etc. A typical list went, "Stairs, Hall, Lounge, Door, Closet, Shelf, Bed, Chair, Desk, Lamp, Bookcase, Window." This was List A, which along with list C were the two peg word lists. The Ss in the AB-CD condition were then asked to generate the C list in the same way but in a different setting and with no words used in list A. Once an acceptable list, or lists, was obtained, S was given 30 seconds to study it followed by serial recall trials until a criterion of two perfect recalls was met for each list. He was then instructed that he would be shown a list of objects (List B) which was to be paired with the locations in List A by forming a mental image of the first object at the first location, the second object at the second location, and so on. The names of the 12 objects were projected on the wall at a 5-second rate followed by a serial recall trial. If a perfect recall was not obtained the procedure was repeated until that criterion had been met. At this point, S was shown either List A again or List C, depending on the condition, and given 30 seconds to study it. A second list of object names (List D) was then learned under the same conditions as List B, followed by a one-minute period during which S wrote backwards from 200 by 3's.

For the recall task, Ss were asked to serially recall List A, then List B, List C (in the AB-CD condition) and finally, List D. This was followed by a cued recall task in which List A alone or A and C were given and Ss asked to pair the appropriate B and D terms with them.

The procedure for the two loci-given conditions was identical to that for the loci-generate conditons except these Ss received A and C lists generated by Ss in the loci-generate conditions. They were told to learn the list of locations by imagining themselves walking from location to location.

The procedure for Ss in the ABD control was the same as that for the AB-AD loci-generate group except that when they learned the D items they were told to imagine each together with the corresponding B item for the A list location.

The Ss in the B-D control conditon were merely instructed to learn the B and D lists to a criterion of one perfect serial recall as they were presented. They did not learn the A or C lists.

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